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CHLORIDE ABSORPTION BY ROOT, LEAF AND FLORAL TISSUES OF *PETUNIA*

J. H. Jooste

(Department of Botany, University of Stellenbosch)

Abstract

Chloride absorption by root, leaf and floral tissues of *Petunia* was compared at two temperatures (30 and 2 °C), employing different absorption periods, and in the presence and absence of a desorption treatment. All treatments revealed highest absorption by floral tissue. This was further confirmed by the absorption of chloride by the various tissues from solutions in the low (0–1 mM) and high (1–50 mM) concentration ranges.

The results offer a possible explanation for the observed effects of organic and inorganic solutes on the longevity of cut flowers.

Uittreksel

CHLORIEDOPNAME DEUR WORTEL-, BLAAR- EN BLOMWEEFSEL VAN *PETUNIA*

Die opname van chloried deur wortel-, blaar- en blomweefsel van *Petunia* is by twee temperature (30 en 2 °C), met verskillende tydperke van opname en met en sonder 'n desorpsiebehandeling vergelyk. By alle behandelings is die hoogste opname met blomweefsel verkry. Dit is verder bevestig deur die opname van chloried deur die verskillende weefsels uit oplossings in die lae (0–1 mM) en hoë (1–50 mM) konsentrasiegebiede.

Die resultate bied 'n moontlike verklaring vir die waargenome effek van opgeloste organiese en anorganiese stowwe op die houvermoë van snyblomme.

Introduction

Halevy and Mayak (1974) observed that treatments to improve the quality and longevity of cut flowers frequently have the effect that the foliage leaves desiccate. The lack of data on the uptake of solutes by floral tissue was strongly emphasised by Halevy (pers. comm.).

Borohov, Tirosh and Halevy (1976) obtained lower values for ABA content and water deficit in petals of sucrose-treated flowers than in controls. They concluded that the effect of sucrose on the ABA content of the petals was at least partly due to its effect on changes in water deficit in the petals.

In the present study, a comparison was made of the uptake of chloride by root tips, leaf discs and discs of the petals of *Petunia*.

Material and Methods

Seedlings of *Petunia* x Hybrida obtained from a local nursery were placed in 3 ℓ containers filled with half-strength culture solution—solution No. 1 of Hoagland and Arnon (1938), in which Fe-EDTA was used as the Fe source. The plants were

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allowed to grow for two weeks, after which they were transferred to full-strength culture solution. At first the culture solutions were renewed fortnightly, but later at weekly intervals. The solutions were replenished with deionised water daily and continually aerated.

The plants were cultivated in a growth chamber, with a daily photoperiod of 14 h (28 ± 2 °C) and light intensity of c. 7 000 lux—until they were flowering profusely. At this time experimental material was obtained as follows: discs, 5 mm in diameter, were cut from the youngest fully mature foliage leaves as well as from the petals of fully open flowers, and the apical 10–15 mm segments of the roots were excised, and immediately placed in 0,5 mM $CaSO_4$ solution. Foliage leaf and petal samples consisted of at least 50 and 80 discs respectively; samples of root tissue had a fresh mass corresponding to 50 leaf discs (c. 0,5 g).

The tissue samples were placed in nylon gauze bags, and immersed in a second 0,5 mM $CaSO_4$ solution at 30 °C for one hour, before they were transferred to the experimental solutions, in which their chloride uptake was to be studied.

Two experiments were conducted. In the first, the uptake of chloride was studied at 30 and 2 °C, with and without a desorption treatment. The experimental solution contained 0,5 mM KCl, labelled with ^{36}Cl, and 0,5 mM $CaSO_4$. The desorption medium was identical to the experimental solution, except for the ^{36}Cl, and was kept at 2 °C. Following absorption periods of 10, 30 and 60 minutes, at 30 and 2 °C, half of the samples were subjected to a desorption treatment of 30 minutes.

In the second experiment the chloride concentration varied from 0,02 to 50 mM, thereby including both so-called ''low'' and ''high'' concentration ranges. All solutions contained KCl, labelled with ^{36}Cl, in 0,5 mM $CaSO_4$. Each desorption solution had the same chloride content as the experimental solution, was also made up with 0,5 mM $CaSO_4$ solution and was kept at 2 °C, but did not contain ^{36}Cl. At each chloride level an absorption period of one hour was followed by a desorption period of 30 minutes.

Following the absorption periods in the different experimental solutions, each sample was rinsed for a total of one minute in a series of four beakers, each containing 200 mℓ deionised water. For the desorption treatment, the samples were transferred (after rinsing) to the desorption solution, following which they were rinsed again as above.

After a brief drying period (too dry material was difficult to remove from the nylon gauze bags) the tissues were placed in scintillation vials and suspended in 5 mℓ Insta-gel (Packard Instrument Co.), and radioactivity determined by means of a Beckman LS–133 scintillation system. The amount of absorbed chloride was subsequently calculated.

At least two replicates of each treatment were employed. In view of the very high degree of uniformity in the data, calculation of the standard error was not considered necessary.

TABLE 1.

Effect of temperature, desorption treatment and length of absorption period on the chloride content of root, leaf and floral tissues of *Petunia*. (Experimental solution contained 0,5 mM KCl (labelled with ^{36}Cl) and 0,5 mM $CaSO_4$. Desorption solution contained 0,5 mM KCl and 0,5 mM $CaSO_4$. Desorption period: 30 minutes at 2 °C. Results represent the average of 2 replicates.)

Absorption period (min.)	Chloride content ($\mu g\ g^{-1}$ fresh mass)			
	30 °C		2 °C	
	No Desorption	Desorption	No Desorption	Desorption
	Root tissue			
10	3,42	1,85	0,58	0,15
30	7,23	5,43	0,75	0,34
60	13,74	9,68	1,05	0,62
	Leaf tissue			
10	0,58	0,12	0,36	0
30	1,29	0,63	0,39	0,16
60	1,49	1,61	0,56	0,28
	Floral tissue			
10	3,57	2,67	1,16	0,25
30	11,91	10,76	2,60	0,51
60	23,28	16,82	3,65	1,62

TABLE 2.

Chloride content of root, leaf and floral tissues following absorption at 2 °C, as a percentage of that following absorption at 30 °C.

	Absorption period (min.)	No Desorption	Desorption	
		Root tissue		
	10	17,0	8,1	
	30	10,4	6,3	
	60	7,6	6,4	
		Leaf tissue		
	10	62,2	0	
	30	30,2	25,4	
	60	37,6	17,4	
		Floral tissue		
	10	32,5	9,4	
	30	21,8	4,7	
	60	15,7	9,6	

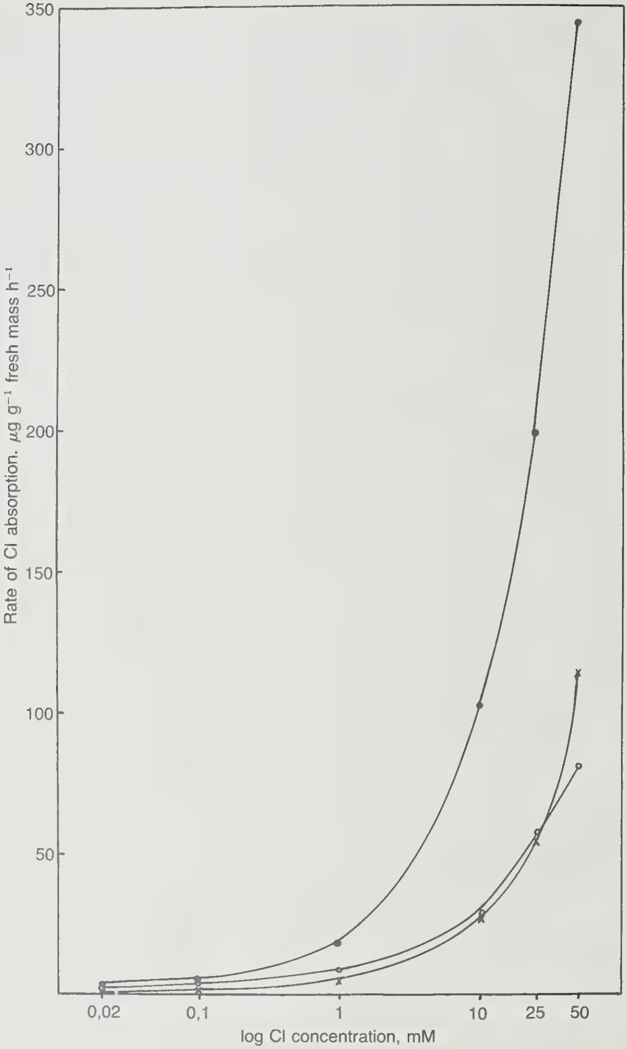

Fig. 1.

Rate of chloride absorption by root (o——o), leaf (x———x) and floral (●——●) tissues in the low (0,02–1 mM) and high (1–50 mM) concentration ranges. Chloride supplied as KCl (labelled with ^{36}Cl) in 0,5 mM $CaSO_4$ solution. Absorption period: 1 h at 30 °C, followed by desorption for 30 minutes in solutions of KCl plus $CaSO_4$ at 2 °C.

RESULTS AND DISCUSSION

Of the three different tissues under investigation, the petal discs absorbed chloride at the highest rate whilst the foliage leaf discs did so at the lowest rate (Table 1). The depressing effect of low temperature on chloride absorption is apparent in all instances, but is better illustrated in Table 2. In Table 2, the high values for foliage leaf tissue compared to root and petal tissues where no desorption treatment was employed (i.e. measuring both metabolic and passive components of absorption), are perhaps indicative of a greater passive component in the uptake of chloride by foliage than by the other tissues.

Any doubt about the greater absorption ability of petal tissue as compared to root and foliage leaf tissues, is ruled out by the absorption curves in Figure 1. The root tips and foliage leaf discs absorbed chloride at virtually the same rate in all the treatments except at the highest chloride concentration where the foliage leaf discs yielded higher values than the root tips. Uptake by petal tissue greatly exceeded that of the other two tissues at all concentrations above 0,1 mM. This suggests that chloride absorption by the petal discs is largely an active process.

These findings might help to explain the fact that longevity of cut flowers is prolonged by certain organic and inorganic solutes, whereas the foliage leaves frequently desiccate under these conditions. Active solute absorption by petal tissue would bring about a lowering of water potential, stimulating water absorption, whereas a high concentration of solutes in the free space of foliage leaf tissue, not accompanied by the same degree of active absorption, would actually induce the reverse effect—an outward movement of water, leading to desiccation.

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